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BRIARCLIFF MANOR, NY 10510

EXAMINER	
BROOME, SAID A	

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2628	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/539,387	GERRITSEN ET AL.	
	Examiner	Art Unit	
	Said Broome	2628	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _18 June 2010_.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _2-6,8,9,11-13,15,16,19 and 20_ is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) _6_ is/are allowed.

6)☒ Claim(s) _2,3,5,8,9,11,13 and 15_ is/are rejected.

7)☒ Claim(s) _4,12,16,19 and 20_ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. This office action is in response to an amendment filed on 6/18/2010.
2. Claims 2-4, 8, 9, 11-13, 15, 16 and 19 have been amended by the applicant.
3. Claims 5 and 6 have been previously presented.
4. Claims 1, 7, 10, 14, 17, 18 and 21 has been cancelled.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 2, 3, 5, 8, 9, 11, 13 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Argiro et al. (hereinafter "Argiro", U.S. Patent 5,986,662) in view of Kaufman et al. (hereinafter "Kaufman", US 2004/0125103) and in further view of Buehler (US 2003/0160788).

Regarding claim 2, Argiro teaches the wherein the selecting of one of the plurality of rendering algorithms and/or rendering parameters is based on a-priori knowledge of at least one of the following: the volume, the medical situation, the clinical situation based on at least one of anatomical, medical and clinical knowledge of a medical expert (col. 4 lines 11-16: "*...a protocol that includes preset adjustments for the volume-rendering of the data, based on the type of data that was loaded via the retrieve data set component. This protocol allows for an initial*

volume-rendering of the data that is logical in light of the type of data." and col. 10 lines 43-45: "...*the protocols are generated a priori by clinical testing to determine the most appropriate presets for a particular data set.*").

Regarding claim 3, Argiro and Kaufman fail to teach further including a 3D model of at least one object in the volume, the used one of the plurality of rendering algorithms and/or rendering parameters being selected in accordance with a relationship between each ray position and the at least one object of the 3D model. Buehler teaches further including a 3D model of at least one object in the volume, the used one of the plurality of rendering algorithms and/or rendering parameters being selected in accordance with a relationship between each ray position and the at least one object of the 3D model (¶0047 lines 3-5: "...*voxel ray tracers are preferably configured to conduct perspective ray tracing where the rays diverge with each cast.*", *in which a rendering parameter, such as implementation of a perspective ray tracing, is implemented based on the bundled position of the rays, in relation to a 3D model, Fig. 1a, in which the perspective ray tracing rendering parameters are executed in response to determination of ray whose positions have changed or diverged, in to a ray bundle*). Therefore it would have been obvious to one skilled in the art at the time of invention to modify the volume rendering of Argiro and contributing pixel values of Kaufman with the selected rendering parameters of Buehler because this modification would enable efficient rendering of a volume data set through providing particular rendering parameters based on certain positions of the ray as is traverse through data, thereby improving rendering accuracy of the data traversed by the ray by enabling parameters of the rendering to be provided in response to the position of the ray.

Regarding claim 5, Argiro teaches a rule prescribes for each of the plurality of ray positions at least one processing action at least in dependence on processing results of ray position along the ray that already been processed (col. 3 lines 1-8: "*...ray casting, the volume is positioned behind the picture plane, and a ray is projected perpendicularly from each pixel in the picture plane through the volume behind the pixel. As each ray penetrates the volume, it accumulates the properties of the voxels it passes through... The properties accumulate more quickly or more slowly depending on the transparency of the voxels.*", *in which a ray processes results of the ray at positions that have already been processed using an accumulation processing action of the volume rendering protocol*).

Regarding claim 8, Argiro teaches wherein each of the protocols corresponding to one of a plurality of anatomical regions of the patient (col. 11 lines 7-17: "*...there are 1-N protocols 186, where N is the number of protocols 186...The external configuration file specifies which protocol selector fields are to be matched with which protocol names.*" and col. 4 lines 11-16 and 25-29: "*...a protocol that includes preset adjustments for the volume-rendering of the data, based on the type of data that was loaded via the retrieve data set component. This protocol allows for an initial volume-rendering of the data that is logical in light of the type of data...also providing different presets of those controls that correspond to particular types of anatomical or other data that is commonly encountered.*", *in which the protocol file includes a plurality of protocols, which are preset or pre-designated for a related type of data, such as a anatomical region*).

Regarding claim 9, Argiro teaches a system for visualizing a three-dimensional (hereinafter "3D") volume of a patient (col. 6 lines 19-28: "*The Advanced Diagnostic Viewer*

(ADV) is a three-dimensional medical imaging workstation, comprised of software running on general-purpose, high-performance three-dimensional graphics hardware. The invention provides both a two-dimensional and a three-dimensional environment in which to view voluminous data organized into a plurality of voxels, each voxel having at least a voxel value. One particular embodiment of the invention provides a diagnostic environment for medical professionals such as radiologists." *and is illustrated in Fig. 1: 100*); the system including:

an input which receives a three-dimensional set of medical image data representing voxel values of the 3D volume (col. 4 lines 9-11: "*The retrieve data set component permits a user to load a previously acquired set of voxel data.*");

an output which provides pixel values of a two-dimensional (hereinafter "2D") image representation for rendering (col. 3 lines 10-11: "*...to produce image pixels for display on a computer screen.*"); and

a processor which, under control of a computer program, processes the medical image data set to obtain the 2D image representation (col. 6 lines 19-28: "*The Advanced Diagnostic Viewer (ADV) is a three-dimensional medical imaging workstation, comprised of software running on general-purpose, high-performance three-dimensional graphics hardware. The invention provides both a two-dimensional and a three-dimensional environment in which to view voluminous data organized into a plurality of voxels, each voxel having at least a voxel value* ", *in which the software, or computer program product, causes the general-purpose graphic hardware to display three-dimensional data on a workstation, in which the hardware thereby comprises a processor to implement this display process*) by performing the steps of:

casting a ray from each pixel of the 2D image representation through the volume (col. 3 lines 1-4: "*...ray casting, the volume is positioned behind the picture plane, and a ray is projected perpendicularly from each pixel in the picture plane through the volume behind the pixel.*");

traversing along the ray through at least a plurality of ray positions within the volume (col. 2 line 63 - col. 2 line 8: "*In one method of voxel rendering, called image ordering or ray casting, the volume is positioned behind the picture plane, and a ray is projected perpendicularly from each pixel in the picture plane through the volume behind the pixel. As each ray penetrates the volume, it accumulates the properties of the voxels it passes through and adds them to the corresponding pixel. The properties accumulate more quickly or more slowly depending on the transparency of the voxels.*" and col. 4 lines 11-16: "*...a protocol that includes preset adjustments for the volume-rendering of the data, based on the type of data that was loaded via the retrieve data set component. This protocol allows for an initial volume-rendering of the data that is logical in light of the type of data.*", *in which a ray is cast through portions of volume data with respect to a volume rendering protocol which renders the volume using corresponding penetrated positions of the ray as it traverses the volume*); and

However, Argiro fails to teach at least one storage which stores protocols for switching among a plurality of rendering algorithms and/or rendering parameters and which stores the medical image data set, in accordance with one of the stored protocols selected to select a type of information visualization, selecting one of a plurality of rendering algorithms and/or rendering parameters, in dependence on the ray position, the selected one of the plurality of rendering algorithms and/or rendering parameters changing with the ray position, the selected rendering

algorithm and/or rendering parameter being different for some of the ray positions of the 2D image than for other ray positions of said 2D image, for each of the plurality of ray positions, calculating a contribution to a corresponding pixel value based on at least one voxel value within a predetermined range of the ray position using the selected one of the rendering algorithms and/or rendering parameters for each of the ray positions. Kaufman teaches for each of the plurality of ray positions, calculating a contribution to a corresponding pixel value based on at least one voxel value within a predetermined range of the ray position using the selected one of the rendering algorithms and/or rendering parameters for each of the ray positions (¶0008 lines 3-14: "*Volume rendering is one of the most common techniques for visualizing the 3D scalar field of a continuous object or phenomenon represented by voxels at the grid points of the volume dataset…rays are cast from screen pixels through the volume dataset, and contributions of voxels along these sight rays are used to evaluate the corresponding pixel values.*" and ¶0021 lines 1-12: "*…the present invention is a method and apparatus for performing approximate perspective volumetric ray casting of a three-dimensional (3D) volume dataset…The length of the volume dataset is calculated between the location of the nearest voxel to the viewpoint and the farthest voxel from the viewpoint.*", *in which rays are cast through a volume to produce a contributing pixel value within the entire volume dataset by penetrating the range and length of the dataset, using a selected rendering parameter, such as an approximate perspective ray casting*). Therefore it would have been obvious to one skilled in the art at the time of invention to modify the volume rendering of Argiro with the calculated contributing pixel values of Kaufman because this modification ensures correct display of a volume data set through providing a rendering algorithm enabling the contributing pixel value of each corresponding ray to be

calculated as it traverses through a range of the data set to provide accurate representation of the volume on a display screen.

However, Argiro and Kaufman fail to teach at least one storage which stores protocols for switching among a plurality of rendering algorithms and/or rendering parameters and which stores the medical image data set, in accordance with one of the stored protocols selected to select a type of information visualization, selecting one of a plurality of rendering algorithms and/or rendering parameters, in dependence on the ray position, the selected one of the plurality of rendering algorithms and/or rendering parameters changing with the ray position, the selected rendering algorithm and/or rendering parameter being different for some of the ray positions of the 2D image than for other ray positions of said 2D image. Buehler teaches at least one storage which stores protocols for switching among a plurality of rendering algorithms and/or rendering parameters and which stores the medical image data set (¶0143 lines 1-2: "*The bundle caster 910 recursively advances a position 914 of a ray bundle.*", ¶0144 lines 1-4: "*…the bundle caster provides an individual ray 912 to the ray caster 930.*" and ¶0145 lines 5-8: "*…position 914 that is advanced by the bundle caster 910 and the position 932 that is advanced by the ray caster 930 each have a depth component that corresponds to a pixel depth within the graphical scene 150.*", *where a particular rendering algorithm, such as ray bundle casting, is performed with respect to the position of the rays, therefore enabling switching to a particular algorithm base don the type of data that is analyzed. Therefore this process is stored in memory during execution of the particular rendering algorithm*), in accordance with one of the stored protocols selected to select a type of information visualization, selecting one of a plurality of rendering algorithms and/or rendering parameters, in dependence on the ray position, the selected one of the plurality of

rendering algorithms and/or rendering parameters changing with the ray position (¶0047 lines 3-5: "*...voxel ray tracers are preferably configured to conduct perspective ray tracing where the rays diverge with each cast.*", *in which a rendering parameter, such as implementation of a perspective ray tracing, is implemented based on the bundled position of the rays, in which the perspective ray tracing rendering parameters are executed in response to determination of ray whose positions have changed or diverged, in to a ray bundle*, ¶0015 lines 8-11) the selected rendering algorithm and/or rendering parameter being different for some of the ray positions of the 2D image than for other ray positions of said 2D image (¶0143 lines 1-2: "*The bundle caster 910 recursively advances a position 914 of a ray bundle.*", ¶0144 lines 1-4: "*...the bundle caster provides an individual ray 912 to the ray caster 930.*" and ¶0145 lines 5-8: "*...position 914 that is advanced by the bundle caster 910 and the position 932 that is advanced by the ray caster 930 each have a depth component that corresponds to a pixel depth within the graphical scene 150.*", *in which a selected rendering algorithm, such as ray casting or ray bundle casting, is performed with respect to the position of the rays, whether in an individual or bundled position for pixels that thereby reside within a two dimensional image*). Therefore it would have been obvious to one skilled in the art at the time of invention to modify the volume rendering of Argiro and contributing pixel values of Kaufman with the selected rendering parameters of Buehler because this modification would enable efficient rendering of a volume data set through providing particular rendering parameters based on certain positions of the ray as is traverse through data, thereby improving rendering accuracy of the data traversed by the ray by enabling parameters of the rendering to be provided in response to the position of the ray.

Regarding claim 11, Argiro teaches the computer program is operative to cause the processor to enable a human operator to select at least one protocol form the plurality of stored protocols for processing the volume (col. 12 lines 41-55: "*A user, such as a radiologist or a technician, changes the pre-selected protocol by selecting one of the alternatives 214, which then becomes protocol 212.*"); and store a selection of the human operator in association with an identity of the operator for subsequent retrieval (col. 12 lines 41-55: "*...current protocol 212 initially shows the pre-selected protocol...A user, such as a radiologist or a technician, changes the pre-selected protocol by selecting one of the alternatives 214, which then becomes protocol 212.*", *in which the protocol component of the system, as shown in Fig. 2: 110, enables subsequent user change of pre-selected protocols to a new protocol, in which each of the protocols are retrieved from a plurality of protocols stored in a file,* col. 11 lines 7-17: "*...there are 1-N protocols 186, where N is the number of protocols 186...The external configuration file specifies which protocol selector fields are to be matched with which protocol names.*", *where the system would consequently contain a processing unit to implement the software to of the protocol component to enable subsequent retrieval of user selection and modification to the protocols*).

Regarding claim 13, Argiro teaches a non-transitory computer readable storage medium storing a computer program for causing a processor to process a three-dimensional set of data representing voxel values of a 3D volume (col. 6 lines 19-28: "*The Advanced Diagnostic Viewer (ADV) is a <u>three-dimensional medical imaging workstation, comprised of software running on general-purpose, high-performance three-dimensional graphics hardware</u>. The invention provides both a two-dimensional and a three-dimensional environment in which to view*

voluminous data organized into a plurality of voxels, each voxel having at least a voxel value " *and shown in* Fig. 3: *108, in which the software, or computer program, causes the general-purpose graphic hardware to process three-dimensional data, in which the hardware thereby comprises a non-transitory medium readable by that hardware to use the processor to implement this process*) depicting an anatomical region of a patient (Fig. 3: *122*) to obtain a 2D image having a plurality of pixels of the 3D volume by projecting the 3D volume onto an imaginary 2D projection screen (col. 4 lines 17-34: "*The image gallery component displays these initial volume-rendered images of the data…the user in more particular is able to refine the view or views of the selected image. The examination viewer component provides the user with exacting controls in the viewing of the image…The examination viewer component also allows the user to fly around and through the data, to obtain the correct view sought. The user is able to select a number of snapshots of such views, or create a video recording of the views. The report generator/viewer component permits the user to assemble these views…*" and col. 14 lines 25-32: "*…viewer component 114 permits display of an image of a patient's data with selected settings by volume view and…by inside view, outside view, and MPR orthogonal or oblique views; and, by volume view only, which is a large three-dimensional rendering.*", *where the volume data is projected onto a display to obtain a two-dimensional representation on a screen from a defined point of view*) by controlling the processor to perform the steps of:

from a memory which stores a plurality of rendering algorithms/parameters, selecting a subset of the rendering algorithm/parameters in accordance with an anatomical region depicted by the 3D volume (col. 11 lines 7-17: "*…there are 1-N protocols 186, where N is the number of protocols 186…The external configuration file specifies which protocol selector fields are to be*

matched with which protocol names." and col. 4 lines 11-16 and 25-29: "*...a protocol that includes preset adjustments for the volume-rendering of the data, based on the type of data that was loaded via the retrieve data set component. This protocol allows for an initial volume-rendering of the data that is logical in light of the type of data...also providing different presets of those controls that correspond to particular types of anatomical or other data that is commonly encountered.*");

casting a ray through each pixel of the 2D image and into the 3D volume (col. 3 lines 1-4: "*...ray casting, the volume is positioned behind the picture plane, and a ray is projected perpendicularly from each pixel in the picture plane through the volume behind the pixel.*"); and

stepping along the ray through at least a plurality of ray positions along the ray within the volume under control of a protocol that selects one of the subset of rendering algorithms/ parameters to be implemented for each ray position along the ray (col. 2 line 63 - col. 2 line 8: "*In one method of voxel rendering, called image ordering or ray casting, the volume is positioned behind the picture plane, and a ray is projected perpendicularly from each pixel in the picture plane through the volume behind the pixel. As each ray penetrates the volume, it accumulates the properties of the voxels it passes through and adds them to the corresponding pixel. The properties accumulate more quickly or more slowly depending on the transparency of the voxels.*" and col. 4 lines 11-16: "*...a protocol that includes preset adjustments for the volume-rendering of the data, based on the type of data that was loaded via the retrieve data set component. This protocol allows for an initial volume-rendering of the data that is logical in light of the type of data.*", *in which a ray is cast through portions of volume data with respect to*

the volume rendering protocol which renders the volume using corresponding penetrated positions along the ray as it traverses the volume);

However, Argiro fails to teach the rendering algorithm/parameters selected for some ray positions being different than the rendering algorithm/parameters selected for other ray positions along the ray, for each of the plurality of ray positions using the selected rendering algorithm/parameter to calculate a contribution to a pixel value of the pixel corresponding to the ray based on at least one voxel value within a predetermined range of the ray position and wherein a plurality of different rendering algorithms/parameters are used to generate the pixel values of the 2D image from the voxels of the 3D volume. Kaufman teaches for each of the plurality of ray positions using the selected rendering algorithm/parameter to calculate a contribution to a pixel value of the pixel corresponding to the ray based on at least one voxel value within a predetermined range of the ray position (¶0008 lines 3-14: "*Volume rendering is one of the most common techniques for visualizing the 3D scalar field of a continuous object or phenomenon represented by voxels at the grid points of the volume dataset...rays are cast from screen pixels through the volume dataset, and contributions of voxels along these sight rays are used to evaluate the corresponding pixel values.*" and ¶0021 lines 1-12: "*...the present invention is a method and apparatus for performing approximate perspective volumetric ray casting of a three-dimensional (3D) volume dataset...The length of the volume dataset is calculated between the location of the nearest voxel to the viewpoint and the farthest voxel from the viewpoint.*", *in which rays are cast through a volume to produce a contributing pixel value within the entire volume dataset by penetrating the range and length of the dataset*), therefore it would have been obvious to one of ordinary skill in art at the time of invention to modify the volume rendering of

Argiro with the calculated contributing pixel values of Kaufman because this modification ensures correct display of a volume data set through providing a rendering algorithm that enables the contributing pixel value of each corresponding ray to be calculated as it traverses through an entire range of the data set to provide accurate representation of the range of the volume on a display screen.

However, Argiro and Kaufman fail to teach the rendering algorithm/parameters selected for some ray positions being different than the rendering algorithm/parameters selected for other ray positions along the ray, and wherein a plurality of different rendering algorithms/parameters are used to generate the pixel values of the 2D image from the voxels of the 3D volume. Buehler teaches the rendering algorithm/parameters selected for some ray positions being different than the rendering algorithm/parameters selected for other ray positions along the ray (¶0143 lines 1-2: "*The bundle caster 910 recursively advances a position 914 of a ray bundle.*", ¶0144 lines 1-4: "*...the bundle caster provides an individual ray 912 to the ray caster 930.*" and ¶0145 lines 5-8: "*...position 914 that is advanced by the bundle caster 910 and the position 932 that is advanced by the ray caster 930 each have a depth component that corresponds to a pixel depth within the graphical scene 150.*", *in which a selected rendering algorithm, such as ray casting or ray bundle casting, is performed with respect to the position along the rays, whether in an individual or bundled position for pixels, that thereby reside within a two dimensional image*), and wherein a plurality of different rendering algorithms/parameters are used to generate the pixel values of the 2D image from the voxels of the 3D volume (¶0022 lines 1-8: "*Ray casting is a method to determine visible objects and pixels within a graphical scene 150 as shown in FIG. 1a. Ray casting is one method of conducting ray tracing that advances (casts) one ray for each*

pixel within the graphical scene 150 from the perspective viewer 106. With each cast one or more graphical objects are tested against each ray to see if the ray has "collided" with the object..." and ¶0047 lines 3-5: "*...voxel ray tracers are preferably configured to conduct perspective ray tracing where the rays diverge with each cast.*", *in which different rendering parameters are utilized, such as traditional ray casting, and perspective ray tracing rendering*). Therefore it would have been obvious to one skilled in the art at the time of invention to modify the volume rendering of Argiro and contributing pixel values of Kaufman with the selected rendering parameters of Buehler because this modification would enable efficient rendering of a volume data set through providing particular rendering parameters based on certain positions of the ray as is traverse through data, thereby improving rendering accuracy of the data traversed by the ray by enabling parameters of the rendering to be provided in response to the position of the ray.

Regarding claim 15, Argiro teaches a method of visualizing a 3D volume by processing a three-dimensional set of data representing an anatomical region of a patient (Fig.3: *122*), which 3D volume is defined by a three-dimensional set of data representing voxel values of a 3D array of voxels of the 3D volume (col. 2 line 67 - col. 3 line 4: "*In one method of voxel rendering...or ray casting, the volume is positioned behind the picture plane, and a ray is projected perpendicularly from each pixel in the picture plane through the volume behind the pixel.*"), as a 2D image defined by pixel values of a 2D array of pixels of a 2D image on an imaginary 2D projection screen (col. 4 lines 17-34: "*The image gallery component displays these initial volume-rendered images of the data...the user in more particular is able to refine the view or views of the selected image. The examination viewer component provides the user with exacting*

controls in the viewing of the image...The examination viewer component also allows the user to fly around and through the data, to obtain the correct view sought. The user is able to select a number of snapshots of such views, or create a video recording of the views. The report generator/viewer component permits the user to assemble these views...", *where the volume data is projected onto a display to obtain a two-dimensional representation on a screen*), the method comprising:

with one or more processors (Fig. 1: *100*):

casting a ray from each pixel into the 3D volume (col. 3 lines 1-4: "*...ray casting, the volume is positioned behind the picture plane, and a ray is projected perpendicularly from each pixel in the picture plane through the volume behind the pixel.*"); and

stepping along the ray to each of a plurality of ray positions within the volume under control of a protocol that selects one of the subset of rendering algorithms/parameters in dependence on the ray position along the ray (col. 2 line 63 - col. 2 line 8: "*In one method of voxel rendering, called image ordering or ray casting, the volume is positioned behind the picture plane, and a ray is projected perpendicularly from each pixel in the picture plane through the volume behind the pixel. As each ray penetrates the volume, it accumulates the properties of the voxels it passes through and adds them to the corresponding pixel. The properties accumulate more quickly or more slowly depending on the transparency of the voxels.*" and col. 4 lines 11-16: "*...a protocol that includes preset adjustments for the volume-rendering of the data, based on the type of data that was loaded via the retrieve data set component. This protocol allows for an initial volume-rendering of the data that is logical in light of the type of data.*", *in which a ray is cast through portions of volume data with respect to*

the volume rendering protocol which renders the volume using corresponding penetrated positions of the ray as it traverses the volume); and

at least one of displaying the 2D image on a display monitor (Fig. 10: *208*) and storing the 2D image in a computer memory (Fig. 9: *112*);

However, Argiro fails to teach for some of the ray positions along the ray, selecting different rendering algorithm/parameters than for other ray positions along the ray wherein the selected rendering algorithm/parameter at at least one o the ray position along the ray changes to a different rendering algorithm/parameter, for each of the plurality of ray positions using the selected rendering algorithm/parameter to calculate a contribution to the pixel value of the pixel of the 2D image that corresponds to the ray. Kaufman teaches for each of the plurality of ray positions using the selected rendering algorithm/parameter to calculate a contribution to the pixel value of the pixel of the 2D image that corresponds to the ray (¶0008 lines 3-14: "*Volume rendering is one of the most common techniques for visualizing the 3D scalar field of a continuous object or phenomenon represented by voxels at the grid points of the volume dataset...rays are cast from screen pixels through the volume dataset, and contributions of voxels along these sight rays are used to evaluate the corresponding pixel values.*" and ¶0021 lines 1-12: "*...the present invention is a method and apparatus for performing approximate perspective volumetric ray casting of a three-dimensional (3D) volume dataset...The length of the volume dataset is calculated between the location of the nearest voxel to the viewpoint and the farthest voxel from the viewpoint.*", *in which rays are cast through a volume to produce a contributing pixel value within the entire volume dataset by penetrating the dataset*), therefore it would have been obvious to one of ordinary skill in art at the time of invention to modify the

volume rendering of Argiro with the calculated contributing pixel values of Kaufman because this modification ensures correct display of a volume data set through providing a rendering algorithm that enables the contributing pixel value of each corresponding ray to be calculated as it traverses through an entire range of the data set to provide accurate representation of the volume on a display screen. However, Argiro and Kaufman fail to teach for some of the ray positions along the ray, selecting different rendering algorithm/parameters than for other ray positions along the ray wherein the selected rendering algorithm/parameter at at least one o the ray position along the ray changes to a different rendering algorithm/parameter. Buehler teaches for some of the ray positions along the ray, selecting different rendering algorithm/parameters than for other ray positions along the ray wherein the selected rendering algorithm/parameter at at least one o the ray position along the ray changes to a different rendering algorithm/parameter (¶0143 lines 1-2: "*The bundle caster 910 recursively advances a position 914 of a ray bundle.*", ¶0144 lines 1-4: "*...the bundle caster provides an individual ray 912 to the ray caster 930.*" and ¶0145 lines 5-8: "*...position 914 that is advanced by the bundle caster 910 and the position 932 that is advanced by the ray caster 930 each have a depth component that corresponds to a pixel depth within the graphical scene 150.*", *in which a selected rendering algorithm, such as ray casting or ray bundle casting, is performed in a different manner with respect to the position of the rays, whether in an individual or bundled position for pixels, that thereby reside within a two dimensional image*). Therefore it would have been obvious to one skilled in the art at the time of invention to modify the volume rendering of Argiro and contributing pixel values of Kaufman with the selected rendering parameters of Buehler because this modification would enable efficient rendering of a volume data set through providing particular rendering parameters based

on certain positions of the ray as is traverse through data, thereby improving rendering accuracy of the data traversed by the ray by enabling parameters of the rendering to be provided in response to the position of the ray.

Allowable Subject Matter

Claims 4, 12, 16, 19 and 20 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: In regards to claim 6, the prior art fails to teach a system for visualizing a three-dimensional (hereinafter "3D") volume, in particular for medical applications; the system including: an input for receiving a three-dimensional set of data representing voxel values of the 3D image; a storage for storing the data set; an output for providing pixel values of a two-dimensional (hereinafter "2D") image for rendering; and a processor for, under control of a computer program, processing the data set to obtain a 2-dimensional representation of the volume by projecting the volume onto an imaginary 2D projection screen from a predetermined viewpoint by for each pixel of the 2D projection image: casting a ray from the viewpoint through the pixel and through the volume; traversing along the ray through at least a plurality of ray positions within the volume under control of a protocol that determines a rendering algorithm and/or rendering parameters in dependence on the ray position with the determined rendering algorithms and/or rendering parameters being different for some ray positions than the determined rendering algorithms and/or rendering parameters for other ray positions; and for each of the plurality of ray positions

using a corresponding one of the determined rendering algorithm/parameters to calculate a contribution to a pixel value of the pixel based on at least one voxel value with a predetermined range of ray positions, wherein the protocol is rule-based; wherein a rule prescribes for each of the plurality of ray positions at least one processing action at least in dependence on processing results of ray position along the ray that already been processed wherein the processing action includes at least one of the following: jumping forward or backward along a ray to a particular ray position, and resuming processing from that position; switching a stepping direction along a ray between forward and backward as seen from the viewpoint; changing a step size that determines a next ray position with respect to a current ray position in the stepping direction; changing a 3-dimensional direction of a ray starting from a particular position; switching to another rendering algorithm; adapting rendering parameters for controlling the rendering algorithm; switching to another feature detection method, which determines the type of information that is going to be visualized by the rendering algorithm, therefore claim 6 is allowable.

Response to Arguments

Applicant's arguments filed 6/18/10 have been fully considered but they are not persuasive.

The 35 U.S.C. 101 rejection of claim 13 has been withdrawn due to the amendment to claim 13 to provide a statutory "*non-transitory*" computer readable storage medium.

The applicant argues that claim 9, which has been placed in independent form, now distinguishes over the references of record. However, claim 9 has been rejected over the

references of record in the above office action due to the amendments to claim 9 provided with the applicant's amendment filed 6/18/10.

In regards to claim 13, the applicant argues that the prior art references Buehler fails to cure the shortcomings of Kaufman and Argiro to teach a rendering algorithm or parameter which changes along the ray. However, Buehler teaches implementing ray casting among an entire ray bundle of a plurality of rays (*¶0143 lines 1-2*), as well as performing processing of individual rays (*¶0144 lines 1-4*), thereby providing processing of different parameters, such the amount of rays cast in particular direction. Therefore the applicant's arguments with respect to claim 13 are unpersuasive, and the rejection of claim 13 has been maintained in the above rejection.

In regards to claim 15, the applicant argues that Buehler does not tech a change in the rendering algorithm/parameter. However, Buehler teaches performing a change in the type of rendering parameter utilized for ray casting, such as utilization of a plurality of rays comprised in a ray bundle (*¶0143 lines 1-2*), or processing of individual rays (*¶0144 lines 1-4*). Therefore the applicant's arguments with respect to claim 15 are unpersuasive, and the rejection of claim 15 has been maintained in the above rejection.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO

MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Said Broome whose telephone number is (571)272-2931. The examiner can normally be reached on M-F 8:30am-5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Andrew Wang can be reached on (571)272-0811. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Said Broome/
Primary Examiner, Art Unit 2628